

WHAT IS CLAIMED IS:

1. A mixer comprising:

a balun including two balanced lines each having a first end that is short-circuited and a second end that defines a balanced terminal, and an unbalanced line having a first end that is free and a second end that defines an unbalanced terminal;

a pair of mixer diodes connected to respective ones of the balanced terminals;

an LO port connected to the unbalanced terminal;

a high-pass filter;

an RF port connected to a node between said mixer diodes through said high-pass filter;

a low-pass filter; and

an IF port connected to the node between said mixer diodes through said low-pass filter;

wherein said balun, said pair of mixer diodes, said high-pass filter, and said low-pass filter are integrated into a multilayer substrate that includes a plurality of sheet layers stacked on each other; and

the multilayer substrate has first external terminals that respectively define said LO port, said RF port, and said IF port at the side surfaces thereof, and has second external terminals that define a ground, at least one of the

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second external terminals being arranged between two of the first external terminals.

2. A mixer according to claim 1, wherein each of the balanced lines and the unbalanced line includes strip line electrodes, and is arranged in the lower section of the multilayer substrate with respect to the stacking direction of the multilayer substrate.

3. A mixer according to claim 2, wherein at least one of said high-pass filter and said low-pass filter includes at least one capacitor, each capacitor including at least one capacitor electrode, and is located in the upper section of the multilayer substrate with respect to the stacking direction thereof, a ground electrode being provided between said at least one capacitor electrode and the strip line electrodes.

4. A mixer according to claim 1, wherein the mixer is a single balanced mixer.

5. A mixer according to claim 1, wherein the high-pass filter blocks LO and IF signals and passes only an RF signal.

6. A mixer according to claim 1, wherein the low-pass

filter blocks LO and RF signals and passes only an IF signal.

7. A mixer according to claim 1, wherein the high-pass filter includes an inductor and at least two capacitors.

8. A mixer according to claim 1, wherein the low-pass filter includes at least two inductors and a capacitor.

9. A mixer according to claim 1, wherein the sheet layers of the multilayer substrate are made of ceramic material.

10. A mixer according to claim 1, wherein the multilayer substrate includes strip line electrodes which define the balanced lines and the unbalanced line of the balun, strip line electrodes, capacitor electrodes, and ground electrodes which define the high-pass filter, and a capacitor electrode and ground electrodes which define the low-pass filter.

11. A mixer according to claim 1, wherein the external terminals are arranged to extend from the side surfaces to the bottom surface of the multilayer ceramic substrate.

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the balanced and the unbalanced lines that constitute the balun are provided in the lower section of the multilayer ceramic substrate with respect to the stacking direction.

12. A mixer according to claim 1, wherein the low-pass filter is located in the upper section of the multilayer substrate.

13. A mixer according to claim 1, wherein the balanced and unbalanced lines of the balun include a ground electrode, a capacitor and strip line electrodes, wherein the ground electrode is provided between the capacitor and the strip line electrodes.

14. A converter comprising:
a mixer according to claim 1;
an RF amplifying unit connected to said RF port of said mixer;
a PLL oscillation unit connected to said LO port of said mixer; and
an intermediate frequency amplifying unit connected to said IF port of said mixer.

15. A converter comprising:
a mixer according to claim 2;

an RF amplifying unit connected to said RF port of said mixer;

a PLL oscillation unit connected to said LO port of said mixer; and

an intermediate frequency amplifying unit connected to said IF port of said mixer.

16. A converter comprising:

a mixer according to claim 3;

an RF amplifying unit connected to said RF port of said mixer;

a PLL oscillation unit connected to said LO port of said mixer; and

an intermediate frequency amplifying unit connected to said IF port of said mixer.

17. A converter comprising:

a mixer according to claim 4;

an RF amplifying unit connected to said RF port of said mixer;

a PLL oscillation unit connected to said LO port of said mixer; and

an intermediate frequency amplifying unit connected to said IF port of said mixer.

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